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ROOTED AQUATIC PLANTS IN THE UPPER POTOMAC RIVER BASIN

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ROOTED AQUATIC PLANTS IN THE UPPER POTOMAC RIVER BASIN

by

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CONCLUSIONS

1. Rooted aquatic plants in the Upper Potomac Basin are not a significant factor in the nutrient budget of the Lower Potomac River.
2. In August 1969 the standing crop of rooted aquatic plants in the Upper Potomac River Basin contained 400 pounds of phosphorus (P) and 4400 pounds of nitrogen (N). These quantities are equivalent to approximately 40 percent of the phosphorus and nitrogen in wastewaters discharged to the Upper Potomac River in a single day.
3. Standing crop estimates were made for growths in Antietam Creek, Conococheague Creek and the Potomac River. Other basin streams contained too few growths of rooted plants to merit sampling for standing crop estimates.

INTRODUCTION

Conferees of the Potomac River-Washington Metropolitan Area Enforcement Conference recommended that the Interstate Commission on the Potomac River Basin, the States of Maryland, Virginia, Pennsylvania and West Virginia, the District of Columbia and the Federal Water Pollution Control Administration make joint studies of the entire Potomac Basin to determine detrimental effects on the Potomac River and estuary. Concern developed for the effects of rooted aquatic plants or pond-weeds on the nutrient regimen of the Lower Potomac River and estuary. These plants accumulate and store nutrients during the spring and summer growing season. Upon death and decay of these plants in late summer and autumn, stored nutrients would be released for transport to the lower river and estuary where nuisance algal growths occur. The Regional Director, Middle Atlantic Region, Federal Water Pollution Control Administration, requested the Division of Field Investigations, Cincinnati, to conduct a study of plants in the Upper Potomac River Basin to:

1. Estimate the quantity of phosphorus (P) and organic nitrogen (N) accumulated in rooted aquatic plant growth.
2. Assess the significance of these stored nutrients on the nutrient budget of the Potomac River Basin.

STUDY AREA

The Potomac River portion included in the study extended from Great Falls, Maryland, upstream 220 miles to the confluence of the Savage River, Maryland. Major tributary streams investigated were the Monocacy River, Antietam Creek, Conococheague Creek, South Branch Potomac River, Cacapon River, and Shenandoah River.

The field survey was conducted August 11 to 19, 1969, a period of the year when aquatic plants growths would be expected to reach maximum abundance.

SAMPLING STATION AND METHODS

When possible, sampling stations were located near highway bridge crossings. Bridges provided good vantage points to observe the overall streambed coverage by rooted aquatic plants. For purpose of study, rooted aquatic plants were defined as vascular plants attached to the stream bottom by a root system and submerged except for floating portions of the plants and the macro-alga Chara.

The quantity of rooted aquatic plants was determined when plant growths covered more than five percent of the stream bottom. The percent coverage and quantity of plants for the interstation reaches were estimated by extrapolation. Fifty sampling stations were established in the study area (Figure 1 and Table 1).

Plant samples were taken with an open-ended, steel cylinder, 10 inches in diameter and 36 inches in length. The sampler was forced into the stream bottom with a rotary motion. Entrapped vegetation was removed, damp dried, segregated into species and weighed. Sampling was conducted at 20-foot intervals along a 100-foot transect of the plant growths.

Complete plants representative of the kinds found in the quantitative samples were collected, damp-dried, weighed, frozen on dry ice, and returned to the laboratory. Each specimen was homogenized, freeze-dried, and analyzed for phosphorus (P) and organic nitrogen (N) content.

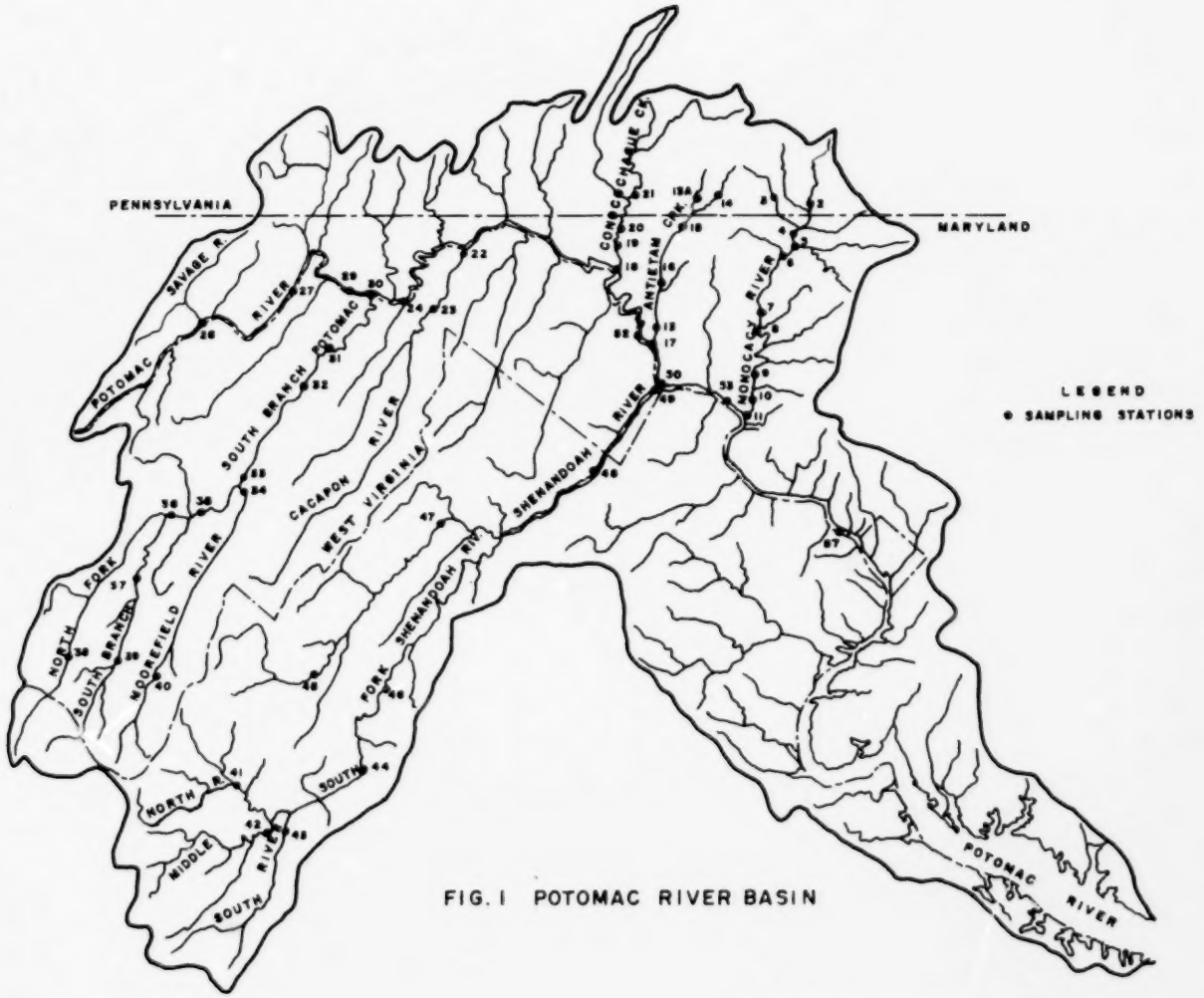

FIG. 1 POTOMAC RIVER BASIN

AQUATIC PLANT GROWTH FACTORS

The establishment and growth of rooted aquatic plants is governed by physical factors such as the availability of suitable substrate, current velocities, water depth and turbidity. Increased current velocity can cause the bottom to become physically unstable for root attachment by scouring away the finer particles in which plants root. Increases in depth or turbidity reduces available sunlight for plant germination and photosynthesis. If adverse conditions persist into the growing season, lush growths may fail to develop in areas that in previous years may have supported abundant growths.

Phosphorus and nitrogen are two major nutrients essential for growth of rooted aquatic plants. Plants assimilate these nutrients and place them in temporary storage. The quantities of nutrients held in storage are dependent upon the standing crop of plants. With the annual die-down of plants in the fall, stored nutrients are slowly released to the stream as plants undergo decomposition. The released nutrients are then available for recycling by other primary producers.

STUDY RESULTS

UPPER POTOMAC RIVER

The main stem of the Upper Potomac River upstream from the Great Falls supported a standing crop of rooted aquatic plants estimated at 700 tons and contained 280 pounds of phosphorus (P) and 3660 pounds of nitrogen (N) (Table 2). Sixty-six percent of the standing crop was contained in an 18 mile reach extending from the confluence of Antietam Creek (Station 17) upstream to where Conococheague Creek enters the Potomac River. The remaining portion of the standing crop was in a 35-mile section of the river extending from the mouth of the South Branch Potomac River upstream to Dawsen, Maryland.

ANTIETAM CREEK

Antietam Creek, Maryland had an estimated 54 tons of rooted aquatic plants with a potential yield of 34 pounds phosphorus and 220 pounds nitrogen (Table 2). Fifty-three percent of the plants were found in two 600-foot sections of Antietam Creek: 1. at Burnside Bridge (Station 13) near Sharpsberg and 2. at Antietam (Station 17) near the mouth of the stream. These two very dense patches of plants were atypical for the stream.

At these points, the stream was shallow and uniform in depth, lacked shading by upper-story stream-side vegetation and supported one species of rooted aquatic vegetation.

Thirty-six percent of the aquatic weeds were contained in a 15-mile reach extending downstream from the mouth of the West Branch of Antietam Creek. The West Branch (Station 13A) supported 11 percent of the standing crop in a one-mile reach of stream flowing through a meadow. The East Branch of Antietam Creek (Station 14) supported too few plants for determining standing crop estimates.

CONOCOCHEAGUE CREEK

Conococheague Creek supported an estimated 128 tons of rooted aquatic plants that contained 80 pounds of phosphorus (P) and 520 pounds of nitrogen (N) (Table 2). The plants were distributed in an eight-mile section of stream located at Station 19.

MONOCACY RIVER, SOUTH BRANCH POTOMAC RIVER, SHENANDOAH RIVER, AND CACAPON RIVER

These streams and their tributaries contained insufficient growths of rooted aquatic plants from which standing crop estimates could be determined. Aquatic plant coverage was less than five percent. Streams had high flows which were considered unseasonable

for the year because of heavy summer rains. The streams and their tributaries were very turbid with visibility reduced to less than 12 inches in depth. High flows and increased turbidity were apparent factors limiting the abundance of rooted aquatic plants in these streams.

SIGNIFICANCE OF ROOTED AQUATIC PLANTS AS RESERVOIRS OF NUTRIENTS

Rooted aquatic plants in the Potomac River Basin are not a significant factor affecting nutrient loading of the Lower Potomac River.

The August standing crop of rooted aquatics in the Potomac River upstream from the Great Falls was estimated to be 880 tons and contained 400 pounds phosphorus (P) and 4400 pounds nitrogen (N). These nutrients are equivalent to approximately 40 percent of the average total pounds of phosphorus and nitrogen in wastewaters discharged to the Upper Potomac River system in a single day [1].

In past years, more extensive growths of rooted aquatic plants in the Upper Basin have been reported[2,3,4]. Even under conditions of a superabundance of rooted aquatic plants, the quantity of phosphorus and nitrogen in storage remains insignificant when compared to the known nutrient discharges. Assuming that stream beds of the Upper Potomac River and its major tributaries were 100 percent covered with plants at densities equal to the maximum observed in this study, total phosphorus and nitrogen in storage would be less than .04 percent and 2.0 percent, respectively, of that discharged annually to the Lower Potomac River as measured at the Great Falls.

Table 1. Location of Aquatic Plant
Sampling Stations,
Upper Potomac River Basin

Station No.	Stream	Location
11	Monocacy River	Md. Rt. 28 Bridge
10	Monocacy River	Lily Pons Bridge, Oland Road, Md.
9	Monocacy River	Md. Rt. 80 Bridge east of Buckeystown, Md.
8	Monocacy River	Gas House Pike Road Bridge near Frederick, Md.
7	Monocacy River	Md. Rt. 26 Bridge at Ceresville, Md.
6	Monocacy River	Md. Rt. 76 Bridge (Le Gore Bridge)
5	Monocacy River	Mumma Ford Bridge, Md.
4	Monocacy River	West of Harvey, Md.
3	Marsh Creek	Greenmount, Pa.
2	Rock Creek	Pa. Rt. 134 Bridge at Barlow, Pa.
17	Antietam Creek	Antietam, Md.
13	Antietam Creek	Burnside Bridge, Antietam Nat. Park, Md.
16	Antietam Creek	Roxbury Road Bridge, Md.
15	Antietam Creek	Md. 60 Bridge
14	E. Branch Antietam Creek	Pa. Rt. 16 Bridge, east of Waynesboro, Pa.
13A	W. Branch Antietam Creek	Pa. Rt. 316, northwest of Waynesboro, Pa.
18	Conococheague Creek	Md. Rt. 68 Bridge, near mouth
19	Conococheague Creek	Conococheague, Md.
20	Conococheague Creek	Broadfording Road Bridge, Md.
21	Conococheague Creek	Pa. Rt. 16 Bridge west of Greencastle, Pa.

Table 1 Cont.

Station No.	Stream	Location
26	Potomac River	Md. Rt. 135 at mouth Savage R., Md.
27	Potomac River	Md. Rt. 9 near Pinto, Md.
29	Potomac River	Toll Bridge at Old Town, Md.
24	Potomac River	W. Va. Rt. 29 Bridge at Paw Paw, W. Va.
52	Potomac River	W. Va. Rt. 48 Bridge at Sheperdstown, W. Va.
50	Potomac River	Harpers Ferry, W. Va.
53	Potomac River	Md. Rt. 15 Bridge at Pt. Rocks, Md.
57	Potomac River	Great Falls, Cheaapeake and Ohio Canal Park, Md.
30	S. Branch, Potomac R.	French Sta. W. Va. near mouth
31	S. Branch Potomac R.	W. Va. Rt. 28 Bridge downstream Romney, W. Va.
32	S. Branch Potomac R.	W. Va. Rt. 28 Bridge upstream Romney, W. Va.
33	S. Branch Potomac R.	U.S. 220 Bridge downstream Moorefield, W. Va.
35	S. Branch Potomac R.	U.S. 220 Bridge downstream Petersburg, W. Va.
36	S. Branch Potomac R.	1 mile downstream Petersburg, W. Va.
37	S. Branch Potomac R.	U.S. 220 Bridge upstream Petersburg, W. Va.
39	S. Branch Potomac R.	U.S. 33 Bridge E. of Franklin, W. Va.
38	N. Fork of S. Branch Potomac River	U. S. 33 Bridge at Judy Gap, W. Va.

Table 1 Cont.

Station No.	Stream	Location
34	S. Fork of S. Branch, Potomac River	U.S. 220 Bridge at Moorefield, W. Va.
40	S. Fork of S. Branch, Potomac River	U. S. 33 Bridge near Brandywine, W.Va.
22	Cacapon River	W.Va. Rt. 9 Bridge near mouth
23	Cacapon River	W.Va. Rt. 9, 2nd Bridge upstream from mouth
49	Shenandoah River	Harpers Ferry National Park, W.Va.
48	Shenandoah River	Va. Rt. 7 Bridge east of Berryville, Va.
46	S. Fork Shenandoah River	Va. Rt. 211 Bridge west of Luray, Va.
44	S. Fork Shenandoah River	Va. Rt. 33 Bridge east of Elkton, Va.
43	South River of S. Fork Shenandoah River	Va. Rt. 256 at Grottoes, Va.
42	Middle River of S. Fork Shenandoah River	Va. Rt. 256 east of Weyers Cave, Va
41	North River of S. Fork Shenandoah River	U. S. 11 Bridge south Mt. Crawford, Va.
47	North Fork Shenandoah River	Va. Rt. 55 Bridge
45	North Fork Shenandoah River	Va. Rt. 42 Bridge at Timberville, Va.

Table 2. Standing Crop of Root Aquatic Plants

in the Upper Potomac River Basin and

Weight of Phosphorus and Organic Nitrogen in Storage

(Streams with Bottoms Covered More than Five Percent by Plants)

Stream	Sta. No.	Mi. of Stream[1]	Aver. Stream Width, Ft.	% Weed Coverage	lbs[2] Weeds per Sq.Ft.	Tons[2] Weeds per Stream Mi.	Plants Contained lbs P per Stream Mi.	Plants Contained lbs N per Stream Mi.
Potomac River	52	18	550	20	.09	26	10	102
"	27	18	105	20	.09	5	2	13
"	29	17	185	30	.06	9	4	40
Antietam Ck.	17	0.1	125	80	.51	15	8	40
"	13	0.1	110	80	.51	13	7	35
"	16	17	75	< 5	-	-	-	-
"	15	15	45	15	.07	1	1	7
"	13A	1	15	30	.50	6	4	36
"	14	-	20	< 5	-	-	-	-
Conococheague Ck.	18	4.5	150	< 5	-	-	-	-
"	19	8	200	30	.10	16	10	55
"	20	14	125	< 5	-	-	-	-
"	21	-	100	< 5	-	-	-	--

[1]Miles of stream estimated as representative of data.

[2]Wet weight

[3]Nutrient data based on phosphorus and nitrogen analyses of plant types present at sampling station (Table 3).

Table 3. Phosphorus and Nitrogen Content

of Rooted Aquatic Plants from the Upper Potomac River Basin

Station No.	Kinds of Plants from Sq. Ft. Sample	% of Total Weeds at Station	Wet Wt. Nutrient Sample(gm)	Dry Wt. Nutrient Sample(gm)	% P Dry Wt.	% P Wet Wt.	% N Dry Wt.	% N Wet Wt.
13	Heterantheria dubi	100	28	1.59	0.44	0.025	2.4	0.13
13A	Elodea canadensis	94	30	4.28	0.25	0.035	2.1	0.30
	Potamogeton crispus	6	31	2.98	0.29	0.028	2.2	0.21
15	E. canadensis	87	42	3.78	0.56	0.050	3.0	0.27
	H. dubi	13	12	1.22	0.48	0.049	2.7	0.27
19	H. dubi	69	25	2.10	0.36	0.030	1.9	0.16
	P. americanus	16	13	1.57	0.30	0.036	2.0	0.24
	E. canadensis	15	18	1.83	0.38	0.030	1.7	0.17
28	Najas flexilis	46	14	1.76	0.17	0.021	1.1	0.14
	H. dubi	29	17	1.30	0.14	0.010	1.8	0.14
	Chara sp.	10	5	0.93	0.12	0.022	0.8	0.15
	E. canadensis	5	6	1.11	0.10	0.018	0.0	0.14
29	P. illinoensis	59	16	1.87	0.24	0.028	2.2	0.25
	P. diversifolius	41	22	3.03	0.12	0.016	1.4	0.19
52	Vallisneria sp.	74	24	1.86	0.19	0.015	2.2	0.17
	H. dubi	11	13	1.03	0.30	0.024	2.6	0.25
	P. illinoensis	8	24	2.87	0.22	0.027	2.2	0.24
	N. guadalupensis	4	14	1.77	0.28	0.036	2.6	0.33
	E. canadensis	3	7	1.30	0.14	0.026	1.8	0.33

ACKNOWLEDGEMENTS

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Chemists, Division of Field Investigations, Cincinnati, EPA, Cincinnati, Ohio, conducted plant nutrient analyses.

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